Relevance of Visual Effects of Volatile Organic Compounds to Human Health Risk Assessment

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Traditional measures of neurotoxicity have included assessment of sensory, cognitive, and motor function. Visual system function and the neurobiological substrates are well characterized across species. Dysfunction in the visual system may be specific or may be surrogate for more global nervous system dysfunction. Recently, numerous studies have reported that chronic exposure to volatile organic compounds may produce deficits in visual function at relatively low-exposure concentrations. In particular, the ability to perceive of visual contrast (the difference between light and dark portions of visual patterns) and/or to distinguish subtle shades of color has been impaired in solvent-exposed populations in comparison with unexposed controls. The populations studied in these reports have been exposed occupationally or otherwise to agents that include toluene, styrene, perchloroethylene, or mixed organic solvents, among others. The presentation will discuss physiological and pharmacological properties of the eye and visual system, including characteristics that may cause visual function to be particularly sensitive to toxic exposures. The physiological basis of visual contrast and pattern perception will be discussed, in addition to the standard screening procedures for assessing visual contrast sensitivity as used in current neurotoxicity field studies. The physiological basis of color perception will be discussed, with distinctions made between congenital color vision deficits, which lead to red/green color confusions in approximately 8% of the male population, and acquired color vision deficits, which often lead initially to blue/yellow confusion errors. The physiological basis of acquired deficits in color perception related to solvent exposures will be discussed, as well as the consequences of visual perception deficits on tasks of everyday living in conjunction with the principles of neurotoxicity risk assessment as described in EPA's neurotoxicity risk assessment guidelines in order to provide a framework for considering the level of concern that should be accorded subtle deficits in visual perception resulting from exposure.